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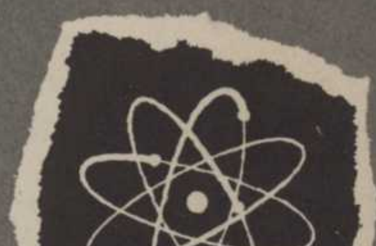
THE ATOM SERVANT OF MAN



IN A YUGOSLAV HOSPITAL room an American doctor gives a dose of medicine to Cardinal Stepinac, who is suffering from a disabling blood disease.

Halfway across the world a group of Japanese scientists are intent on an experiment to learn more about the physiology of the silkworm.

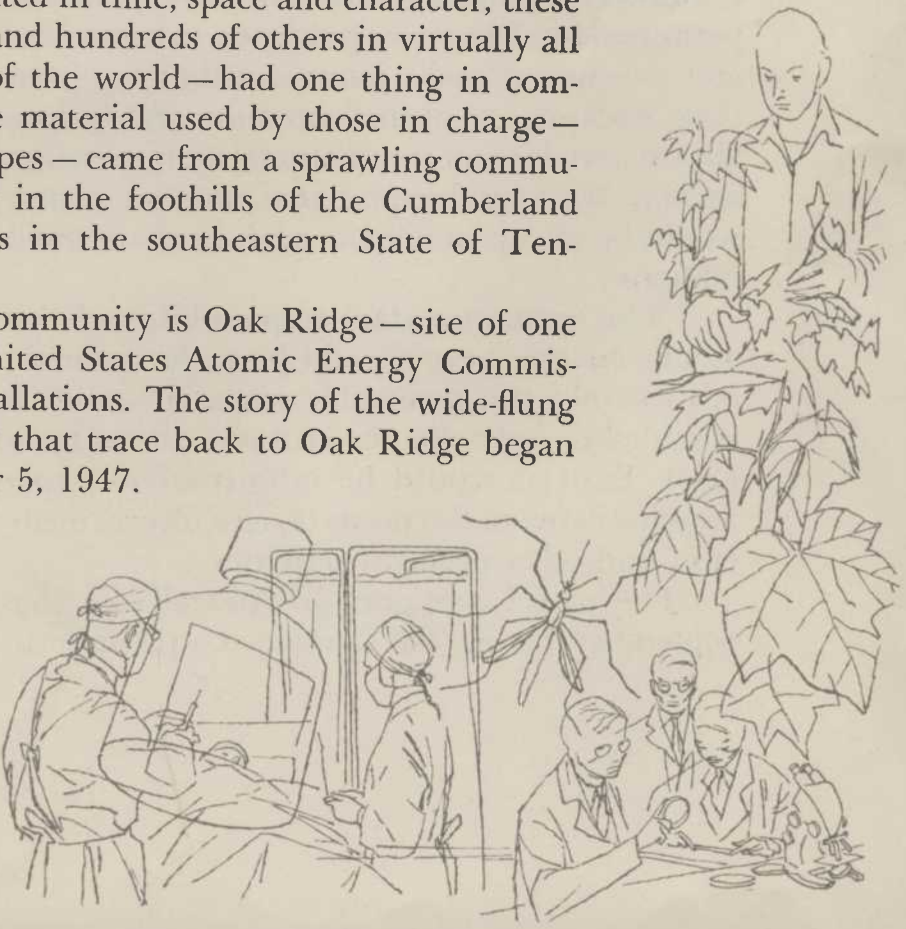
In Rio de Janeiro a physician speaks gently to a mother of five children—he has just treated her for a cancerous growth.

On an experimental farm in Saskatchewan, Canada, agricultural experts continue their research on the effects of certain fertilizers on plant growths.

In Nigeria, British West Africa, scientists "tag" a species of mosquito known to be a yellow fever carrier. They learn its life span and range of flight, permitting an estimation of the spread of yellow fever from the infection source.

Separated in time, space and character, these actions—and hundreds of others in virtually all quarters of the world—had one thing in common. The material used by those in charge—radioisotopes—came from a sprawling community lying in the foothills of the Cumberland Mountains in the southeastern State of Tennessee.

The community is Oak Ridge—site of one of the United States Atomic Energy Commission's installations. The story of the wide-flung operations that trace back to Oak Ridge began September 5, 1947.



On that day a motor truck threaded its way along the winding road that connects the secluded atomic energy site with the airport at Knoxville. The truck's load included a small package destined for Australia.

Measured in terms of money, the value of that package was trifling. But appraised as a symbol, its value may well have been inestimable.

For the package contained radioactive material intended for medical research — which one day may benefit the health of all mankind. And, further, its dispatch to a foreign land was one of the first examples of postwar cooperation in the field of atomic energy — foreshadowing the dramatic offer made by President Eisenhower last December 8 in an address before the United Nations General Assembly.

In that address President Eisenhower said:

"I . . . make the following proposal: the governments principally involved, to the extent permitted by elementary prudence, to begin now and continue to make joint contributions from their stockpiles of normal uranium and fissionable materials to an international atomic energy agency. We would expect that such an agency would be set up under the aegis of the United Nations . . .

"The more important responsibility of this atomic energy agency would be to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind. Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine, and other peaceful activities..."

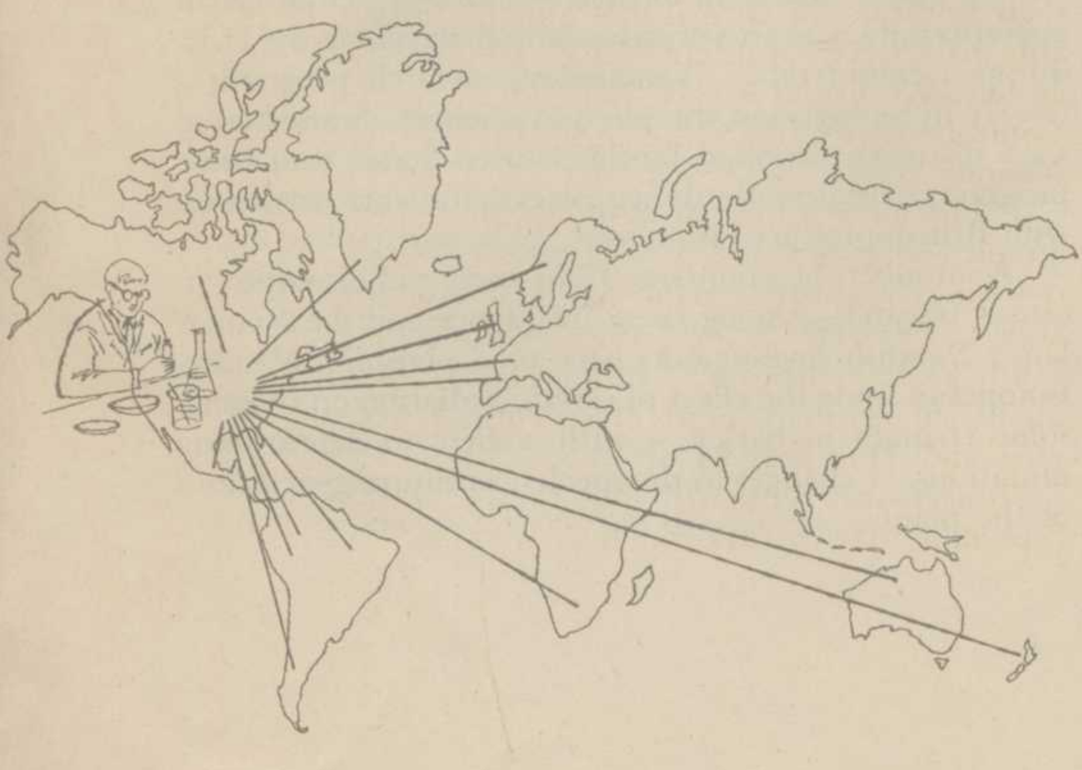
The parcel consigned to Australia on that September day in 1947 contained a phosphorus

radioisotope which was used to treat a patient afflicted with a blood disease.

And it was the first of thousands of such radioactive materials sent in the ensuing six and one-half years to scientists in other countries to fulfill—as President Eisenhower said before the UN—"the needs of agriculture, medicine, and other peaceful activities."

What are these radioactive isotopes? How are they produced? What is the procedure under which the United States shares them with other nations? And what is the philosophy underlying this nation's willingness to make them available to other people?

The word "isotope" comes from two Greek words: "iso," meaning "same," and "topos," meaning "place." The word was coined to describe certain atoms which although different in weight still occupy the same place in the periodic table of elements. Since they are atoms of the same element—such as hydrogen, phosphorus, carbon or iodine, for example—they behave alike chemically. Isotopes, therefore, are like twins that look and act alike but which are different in weight.



Radioactive isotopes, or radioisotopes, as they are called, are atoms that give off radiation and disintegrate to become other kinds of atoms. It is these radiations that make the isotopes valuable to an extent still to be realized.

Some radioisotopes occur naturally, as in uranium, which even before the beginning of the present century led to the discovery of radioactivity. However, most of the radioisotopes now used in the United States and shipped abroad are man-made in the U.S. Atomic Energy Commission's nuclear reactor at Oak Ridge, Tennessee. Some 50,000 radioisotope shipments have been made from this facility since 1946, when Congress authorized such distribution.

Utilization of American-made radioisotopes in the more than forty countries which have received them has been similar to that in the United States, where the two principal uses have been as sources of radiation and as "tracer" atoms.

The following examples indicate the range of utilization of radioisotopes abroad.

In 1947 and 1948 researchers in the United Kingdom received large numbers of isotope shipments from the United States. When the British reactor at Harwell began operations, U.S. export of radioactive materials to the U.K. dropped considerably. Nonetheless, research programs—largely in biology and the physical sciences—were started with materials supplied by the United States, and those programs have doubtlessly set patterns for work carried on with British-produced isotopes.

A number of countries have used radioisotopes in cancer research. Among these are France and the Netherlands. Swedish investigators have used phosphorus radioisotopes to study the effect of certain radiation on chromosome changes in barley — with a view to determining mutations, or changes in the species, in future generations of the plant.

Danish scientists have experimented with mercury radioisotopes as "tracers" to learn the amount of mercury left on plants after spraying with fungicides containing mercury. In tracer experiments of this type the radioactive mercury atoms are combined with normal, or non-radioactive, mercury atoms. The chemical reactions of the radioactive atoms are precisely the same as the non-radioactive atoms, but their presence — even in infinitesimal quantities — may be detected by the use of atomic instruments, such as the Geiger counter.

The Danish scientists found that apples sprayed a single time with mercuric fungicides retained a certain portion of mercury, 98 to 99 per cent of which was found on the outermost layers of the apple peel.

European countries also have been using radioisotopes therapeutically with promising results.

While the greater portion of radioisotopes shipped to the United Kingdom have been used in research, several institutions have used radioactive phosphorus and iodine to treat blood diseases and thyroid disorders.

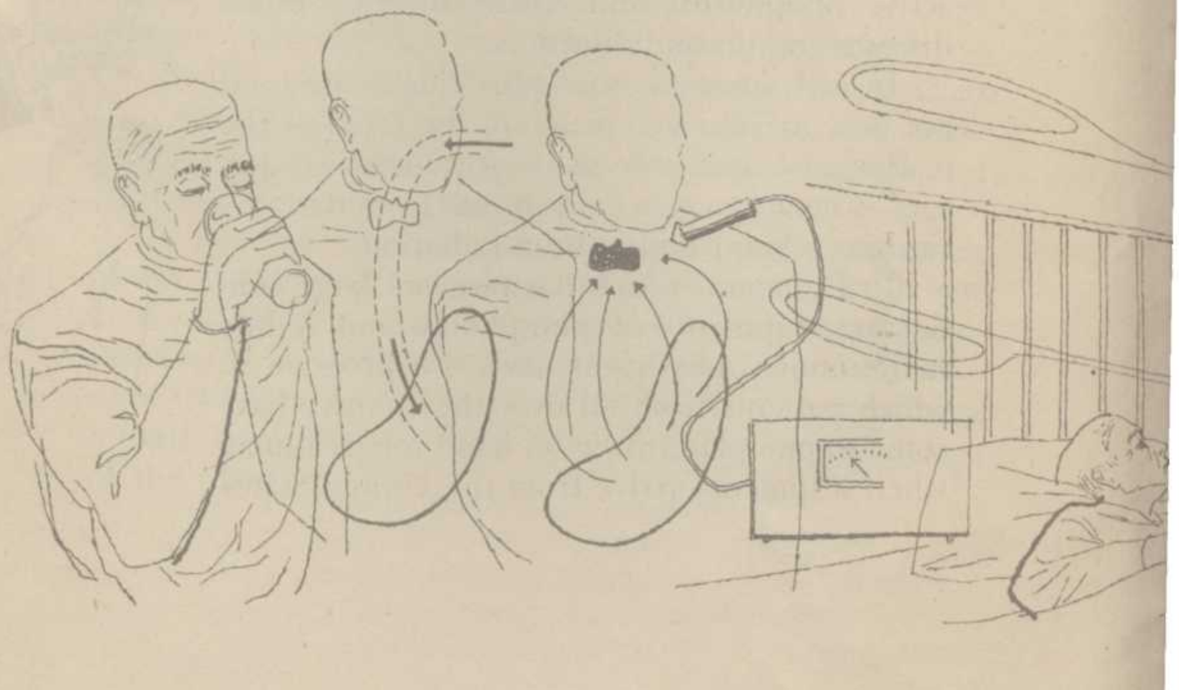
In such instances the radioisotopes are used not only as "tracers" to locate the focus of the malignancy, but also, in greatly increased dosages, as agents to attack the disease by radiation — similar to X-ray and radium radiation.

In Denmark, which has received large continuing shipments of phosphorus and iodine radioisotopes, physicians devised a program in which patients from all over the country have come to one place to be on hand for treatment when shipments arrive from the United States.

After a slow start in utilizing U. S. radioisotopes — due principally to a lack of personnel trained in radioisotope techniques — Latin American countries are now among the largest users of such radioactive materials. These countries have utilized the radioisotopes almost exclusively for therapeutic purposes.

Phosphorus and iodine radioisotopes are most generally used in the Latin American republics. In general, results have followed the pattern observed in the United States and elsewhere. Treatment has been most effective in cases involving chronic leukemia, a blood disease characterized by over-production of white blood corpuscles. In cases of acute leukemia — a disease which almost invariably causes death—let-ups in the ravages of the malady have been obtained which ranged from a few days to more than four months. Treatment of a disease called polycythemia vera — in which red blood corpuscles are over-produced — and of other blood disorders have been satisfactory.

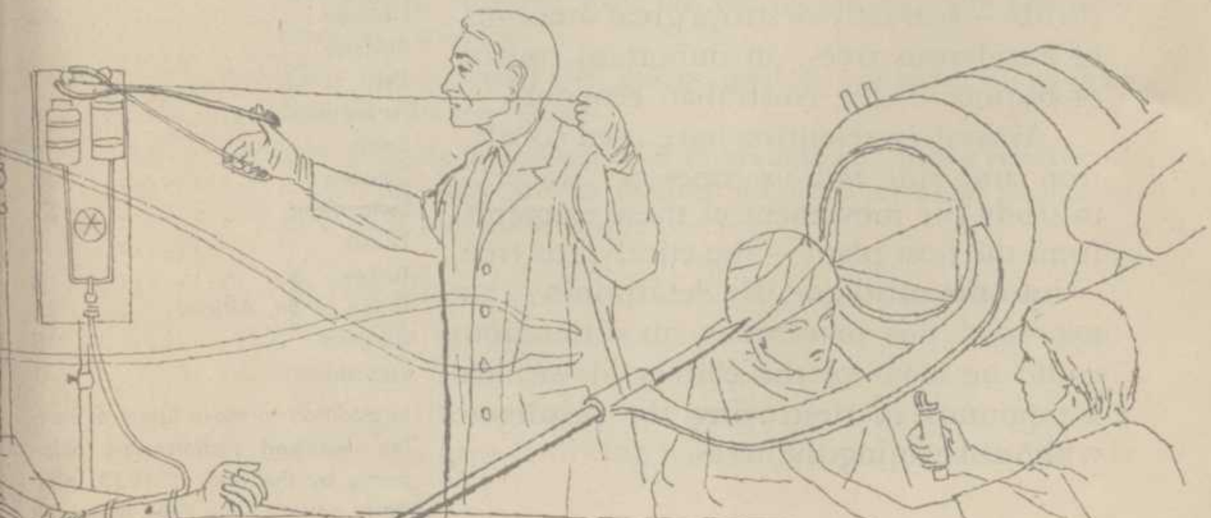
In central Argentina, an institution concentrated on a series of studies of thyroid disorders, using iodine radio-



isotopes. For this study a group of physicians from Massachusetts General Hospital in Boston went to Argentina to help set up the program, which has since proceeded under supervision of trained Argentines.

In Mexico, an investigator has carried on experiments to determine whether radioactive cobalt could serve as a satisfactory substitute for radium. A Peruvian doctor has used phosphorus radioisotopes in combination with other forms of treatment of tumors. Preliminary findings indicate satisfactory results from a combination of surgery and radiotherapy.

Brazil is high on the list of countries receiving radioisotopes from the United States, having received more than 200 shipments by the end of 1953. At first a scarcity of trained personnel precluded their use in pure research programs, confining their utilization almost entirely to medical therapy. However, scientists in São Paulo who received training in the United States have led in coordinating a group devoted to research in the field of the life sciences.



In the Far East, Japan began its participation in the American radioisotope program in March, 1950. Since then, Japanese scientists have conducted research projects in the physical sciences, in life sciences and in industrial research. In some instances the problems studied have an important relation to the Japanese economy. For example, studies have been conducted in connection with rice growing. The Japanese also have investigated the mechanism of calcium deposition in the shell and pearl of the pearl oyster. And they have conducted extensive research in nutrition.

Elsewhere in the far Pacific, scientists have employed radioisotopes to deal with special problems. In Australia, for example, mistletoe — which is a parasitic shrub — annually destroys great amounts of eucalyptus trees, an important source of lumber in the Australian economy.

Australian scientists have used cobalt, iron and zinc radioisotopes as "tracers" to study the movement of these elements from the host plant — the eucalyptus tree — into the mistletoe. By determining the extent of this movement, an estimation could be made of the efficacy of various compounds in destroying the mistletoe without harming the trees.

List of countries and number of radioisotope shipments received by each up to the end of 1953:

Argentina	105
Australia	103
Austria	1
Belgium	131
Bermuda	16
Brazil	211
British West Africa	1
Canada	420
Chile	79
Colombia	5
Cuba	133
Denmark	207
Dominican Republic	1
Egypt	1
England	131
Finland	13
France	90
Germany	6
Gold Coast	1
Guatemala	3
Iceland	5
India	12
Indonesia	3
Israel	6
Italy	28
Japan	227
Lebanon	6
Mexico	47
Netherlands	53
New Zealand	11
Norway	42
Pakistan	5
Peru	13
Portugal	5
Spain	5
Sweden	182
Switzerland	51
Trieste	3
Turkey	5
Union of So. Africa	28
Uruguay	10
Yugoslavia	1

In addition to those listed as having received radioisotope shipments by the end of 1953, nine other nations have been approved as prospective recipients. These are Greece, Ireland, Syria, Thailand, Bolivia, Costa Rica, El Salvador, Honduras, and Paraguay, whose applications to participate in the international distribution were approved February 19, 1954.

These examples barely indicate the scope of utilization of radioisotopes furnished by the United States. Another indication may be found in the table at the left.

Simplicity marks the procedure to be followed by a country wishing to participate in the Atomic Energy Commission's program of international radioisotope distribution. The embassy of the applying country notifies the State Department and names a representative or agent who will handle matters connected with radioisotope shipments. Such representative may be a diplomatic official, a commercial concern, or any other person or corporation selected by the foreign government.

Individual applications for radioisotopes are submitted by the appointed representatives to the Isotopes Division of the Atomic Energy Commission at Oak Ridge. This division, after it has approved the application, issues an authorization for its purchase.

Each application for export of radioisotopes includes a three-point agreement on the part of the applicant. Under this the applicant, on behalf of the government he represents, agrees:

1. **To furnish the U.S. Atomic Energy Commission upon request, or in any event at intervals of not more than one year, results of progress obtained with the use of radioisotopes procured from its facilities;**
2. **That the materials will not be used in a manner other than described in the request;**
3. **To facilitate exchange of information and visits relative to work with radioisotopes between qualified scientists in accordance with normal scientific practice.**

It is as simple as that. But to date no iron curtain country has indicated a desire to participate in the program. Perhaps the third point in the agreement is the deterrent.

Yet it is the willingness to exchange information among qualified scientists working with radioisotopes that extends

almost beyond the bounds of human imagination the possibilities that lie ahead for the betterment of mankind.

For example, the radioisotope is considered by many as the most valuable investigative tool to come into use since the invention in the seventeenth century of the microscope, which made observation of microorganisms possible.

Mention already has been made of the use of radioisotopes as tracer atoms. Since radioactive atoms of an element behave like the ordinary stable atoms of the same element, they go along with them in all chemical and biochemical processes. But because of the radiations given off by the radioactive atoms, they can act as "atomic detectives," the basis for a powerful new analytical technique — the tracer technique.

So sensitive is the method of measuring the radiation from radioisotopes that it is possible to detect the presence of some atoms with hundreds of millions of times the sensitivity possible with any other physical and chemical means now known. This means that in a tracer experiment in biology, it would be possible to detect one-hundred-millionth of an ounce of radioactive material after it has become distributed in an animal as large as a cow.

The unique value of the tracer technique lies in the fact that radioisotopes provide scientists with the ability to follow a specific batch of atoms through a complicated system, regardless of all the other atoms present and of all the chemical processes that may be going on.

It would be possible, for instance, to trace an isotope in a soil nutrient through a plant grown on the soil, through a cow fed on the plant, and, finally, through a rabbit fed on milk obtained from the cow. Even though the isotope would pass through a number of complex processes, its tell-tale radiation would permit its positive identification throughout.

And this extraordinarily effective tracer technique is applicable in the examination of the human body, farm

stock, plant life and an ever widening range of materials used in industry.

Valuable as this tracer technique is in particular investigations, its real worth to mankind lies in the exchange of knowledge gained in researches now being carried on in clinics developing all over the world.

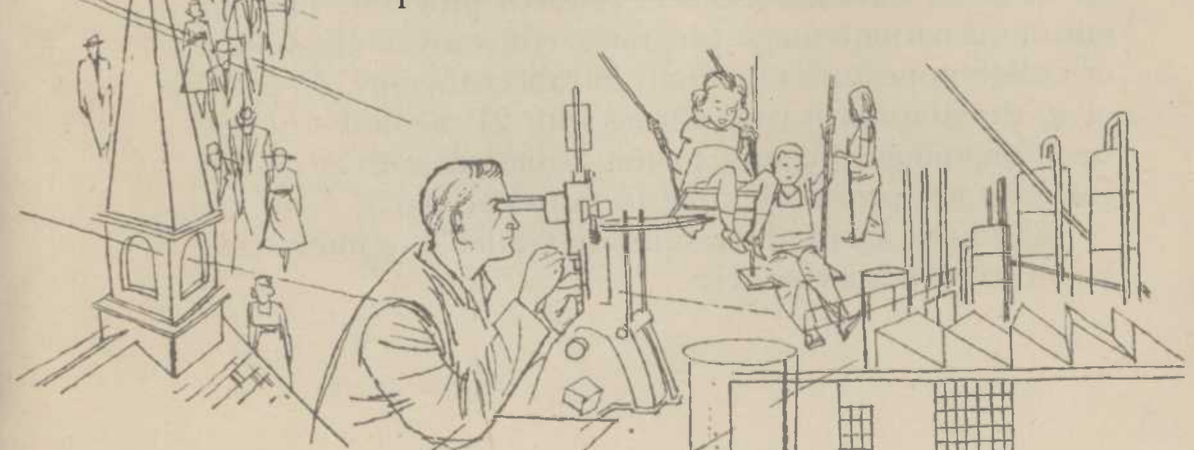
Commenting on the use of radioisotopes—both as tracers and radiation agents—Dr. Paul C. Aebersold, director of the AEC Isotopes Division at Oak Ridge, has this to say:

"It is more than 50 years since the discovery of radium and X-rays. It has taken a good part of that time to develop these materials to their present high degree of usefulness.

"World-wide use of radioisotopes is still in its infancy, but utilization of these isotopes has already crossed the threshold into an era of practical development.

"What developments will take place in the next 50 years cannot be foreseen. But I am of the opinion that the new medical knowledge to be gained in the next few decades will be more important than all other uses of atomic energy."

It is to help attain this goal that the United States has offered to share with all other nations not only the radioisotopes it produces, but also the fruit of continuous and intensive radioisotope research in their utilization.



Oak Ridge does more than produce the radioisotopes sent abroad. Part of the facilities there includes the Oak Ridge National Laboratory, which, like the nuclear reactor, is operated under contract by the Carbide and Carbon Chemicals Division of the Union Carbide and Carbon Corporation, a private organization. The laboratory has a staff of more than 3,000 persons, many of them outstanding scientists. Also there is the Oak Ridge Institute of Nuclear Studies, a non-profit educational corporation owned by 32 universities in southern states.

The relationship between the Laboratory and Institute assures a rich flow of information on nuclear developments into the lecture rooms of the Institute and thence out into the world. Since establishment of the Institute in 1946, its special training division has trained more than 1,500 scientists from throughout the free world in the safe and efficient use of radioisotopes.

Scientists who have taken advantage of the Institute's facilities and its courses of instruction — and who have returned home to spread their knowledge among fellow-countrymen — have come from more than a score of countries. These include Argentina, Belgium, Brazil, Canada, Cuba, Egypt, Finland, Guatemala, India, Israel, Italy, Japan, Mexico, the Netherlands, New Zealand, Norway, Peru, El Salvador, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

In addition to its laboratory and lecture training, the Oak Ridge Institute of Nuclear Studies, through its medical division, conducts a cancer research program. This is one of the nation's major programs to investigate the value of radioisotopes and radiations in cancer therapy. As part of it, the division is cooperating with 21 medical schools in a long-range program to test radiation sources of an intensity not previously used in cancer research.

And here, again, the results are available to interested scientists in other countries.

Taken as a whole, the radioisotope export program and exchange of scientific and technical knowledge was summed up some time ago in a report by the Atomic Energy Commission which declared:

"The program is in keeping with the foreign policy of the United States, which calls for aid to foreign nations in peaceful development, and, even in the absence of international control of atomic energy, constitutes a field in which international cooperation can be increased."

This statement calls to mind the stirring passage with which President Eisenhower concluded his address before the United Nations General Assembly:

"Against the dark background of the atomic bomb, the United States does not wish merely to present strength, but also the desire and the hope for peace . . . The United States pledges before you—and therefore before the world—its determination to help solve the fearful atomic dilemma —to devote its entire heart and mind to find the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life."

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